

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY (SALTERS)

2850

Chemistry for Life

Wednesday

29 MAY 2002

Morning

1 hour 15 minutes

Candidates answer on the question paper.

Additional materials:

Data Sheet for Chemistry (Salters)

Scientific calculator

Candidate Name	Centre Number	Candidate Number											
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TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry (Salters)*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	28	
2	19	
3	8	
4	20	
TOTAL	75	

This question paper consists of 12 printed pages.


1 Ethanol is used as an 'oxygenate' to improve the octane rating of petrol.

(a) (i) Draw the **full structural formula** for ethanol, C_2H_5OH .

[2]

(ii) Draw a dot-cross diagram for ethanol, showing the outer shell electrons only.

[3]

(iii) Use your diagram to state and explain the  bond angle in an ethanol molecule.

Bond angle

Explanation

.....

.....

.....[4]

(b) There are two **structural isomers** of C_2H_6O . Ethanol is one of them.

(i) Give the structural formula of the other isomer.

[2]

(ii) Explain what *structural isomer* means.

.....
.....
.....[3]

(iii) Name the **functional group** in the structure you have drawn in (i).

.....[1]

(c) The octane rating of ethanol is 111. 'Straight-run' gasoline has an octane rating of 70. How does the higher rating affect the performance of the fuel?

.....
.....
.....[2]

(d) Oxygenates are also added to petrol because they are thought to make the fuel produce less carbon monoxide when it burns in an engine.

(i) Suggest a reason why less carbon monoxide might be produced.

.....
.....
.....[2]

(ii) Describe **one** polluting effect of carbon monoxide.

.....
.....[2]

- (e) Ethanol mixes with the hydrocarbons in petrol, one of which is octane. How would the entropy of a mixture of ethanol and octane compare with the entropies of the two liquids separately? Give a reason for your answer.

.....
.....
.....[3]

- (f) Draw a labelled diagram of a **simple** apparatus you would use to measure the enthalpy change of combustion of ethanol in the laboratory.

[4]

[Total : 28]

(c) This part of the question considers the efficiency of hydrogen as a fuel, in terms of how much energy is released when it burns.

(i) Write a balanced equation for the reaction of one mole of hydrogen with half a mole of oxygen.

[1]

(ii) Use the data below to calculate a value for the enthalpy change of combustion of hydrogen.

bond	bond enthalpy/kJ mol ⁻¹
H—H	+436
H—O	+464
O=O	+498

Answer [4]

(iii) Calculate the amount of energy, in kJ, released by burning **one kilogram** of hydrogen. This value is called the **energy density** of hydrogen.
[A_r: H,1.0]

Answer kJ kg⁻¹ [2]

(iv) The energy density of octane is 48 000 kJ kg⁻¹. In terms of energy, how does octane compare with hydrogen as a fuel for cars?

.....
.....[1]

3 In the early years of the twentieth century, radium-containing paint was used on the hands of wrist watches. The paint glowed in the dark because of its radioactivity. The women who painted the watches swallowed a lot of radium because they licked their brushes to get a finer point. Many became ill with radiation-related diseases.

(a) The commonest isotope of radium is Ra-226 which decays by α -decay.

(i) Write a nuclear equation for this process.

[3]

(ii) Would you expect the wrist of the person wearing the watch to be affected by the α -particles? Give a reason.

.....
.....[2]

(b) Radium was absorbed into the bones of those who painted the watch dials. This is because radium ions replaced calcium ions.

(i) What is the charge on a calcium ion?.....[1]

(ii) Explain why the charge on a radium ion is the same as the charge on a calcium ion.

.....
.....
.....[2]

[Total : 8]

4 The element tellurium, Te (atomic number 52), is a non-metal in the same group of the Periodic Table as sulphur. Tellurium is added to steel to improve its 'machinability'. It was also important in the historical development of the Periodic Table.

(a) Use your knowledge of the similarities in a group of the Periodic Table to answer the following questions.

(i) State, with a reason, the number of electrons in the outer electron shell of a tellurium atom.

.....
[2]

(ii) Tellurium forms a smelly compound with hydrogen. Suggest a formula for this compound.

.....[1]

(b) Use the data given to work out a value for the first ionisation enthalpy of tellurium and write it in the box below.

element	1st ionisation enthalpy/ kJ mol^{-1}
S	+1000
Se	+940
Te	

Explain how you arrived at your answer.

[2]

(c) Tellurium (atomic number 52) has seven major isotopes, including Te-122 and Te-130.

(i) Complete the Table to show the number of protons, neutrons and electrons in atoms of these two isotopes.

isotope	protons	neutrons	electrons
Te-122			
Te-130			

[4]

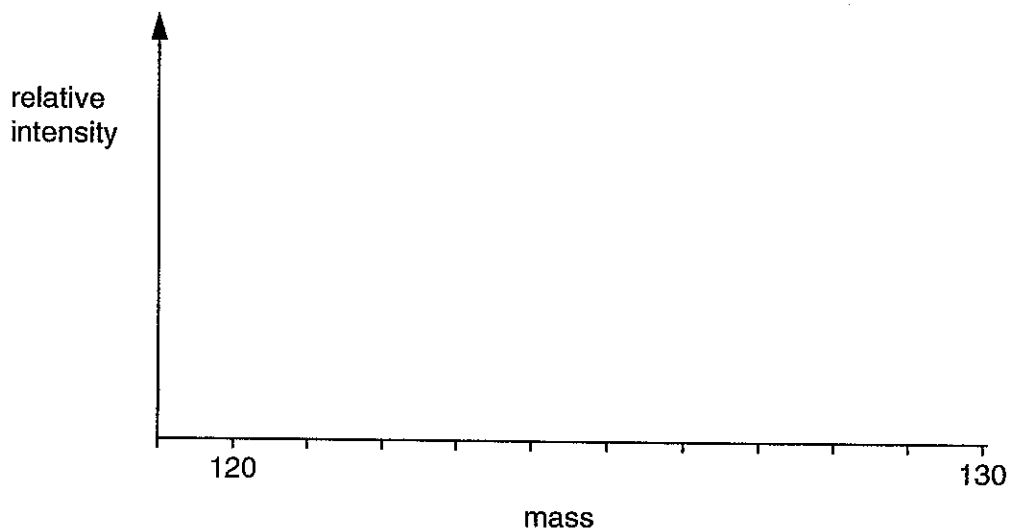
(ii) The Table below shows the relative abundances of the isotopes of tellurium.

mass number	relative abundance	mass no. multiplied by relative abundance
122	2.46%	300.12
123	0.87%	107.01
124	4.61%	571.64
125	6.99%	873.75
126	18.71%	2357.46
128	31.79%	4069.12
130	34.49%	

Complete the empty box in the Table and use the Table to calculate a value for the relative atomic mass of tellurium to **two decimal places**.

Answer [4]

- (iii) Use the Table to sketch the **three main peaks** in the mass spectrum of tellurium on the axes below.



[3]

- (d) (i) The relative atomic mass (A_r) of iodine is 126.9 which is smaller than that of tellurium.

In spite of this, Mendeleev placed **Te** in Group 6 and **I** in Group 7 of his Periodic Table.

Suggest why he did this.

.....

 [2]

- (ii) Why are we much more sure today that **Te** and **I** are in the right positions?

.....
 [2]

[Total : 20]